Building blocks of marine calcifiers foraminifera as examples of nano to macroscale arrangements in biominerals

Sadekov, A.[1], Collins, S.[2], Johnstone, D.[2], Lampronti, G.I.[2] and McCulloch, M.[1]

[1] The University of Western Australia, Australia, [2] University of Cambridge, United Kingdom

Major marine calcifiers, such as corals, foraminifera and coccolithophores, produce intricate skeletal forms made out of calcium carbonate. These skeletal forms are very complex in arrangement and design at macro to nanoscale. To achieve such organisation, marine calcifiers evolved to blur the boundary between organic and inorganic chemistry by incorporating organic molecules and biological templates into crystals of calcium carbonates. In this work, we present results of multidisciplinary study on shell arrangements and biomineralisation of planktonic foraminifera. We will demonstrate that the shell of this unicellular organism is highly ordered from macro to nanoscale. Using electron backscatter diffraction (EBSD) and general scanning electron microscopy (SEM) we will show how large-scale arrangement in crystallinity governs the shape and morphology of foraminiferal shells and is based on the layout of calcification units that are as small as tens of nanometres. We will also present results from a combination of high resolution transition electron microscopy (TEM), electron diffraction and electron precession to describe complex nanoscale assemblies in biominerals. Moreover, using high resolution electron energy loss spectroscopy (EELS), we will link this high nanoscale order with the presence of organic framework. This organic matrix serves an essential role in biomineral formation, which we will discuss by providing a comprehensive biomineralisation model of these group of marine calcifiers.

<Authors acknowledge support from ARC for Centre of Excellence for Coral Reef Studies >